

ABSTRACT OF THE DISCLOSURE

The invention is using the phase information contained in the diffraction light of the grating, to analyze the velocity and the displacement of the object having the grating attached. By using the relative placement of the optical elements, the entire optical scale system has high tolerance to the phase difference that is caused by the grating optical scale and the relative calibration error of the grating optical scale and the laser light head. Due to the light beam is focused on the diffraction grating, the wave-front of the signal light is relatively not impacted by the geometrical characteristics of the diffraction grating, the geometrical characteristics of the diffraction grating includes something like the interval is not even or the surface is bending. The excellent signal visibility can be obtained by applying the linear grating, radial grating, or the cylindrical grating as the grating in the design according to the present invention.